



Original / *Obesidad*

## Association between childhood obesity and oral hygiene status

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### Abstract

**Objective:** The purpose of this study was to evaluate the oral hygiene status in pediatric obese patients.

**Methods:** A cross-sectional study was conducted from 2011 to 2012, which evaluated 180 Brazilian pediatric patients, 6-14 years old, girls and boys, recruited according to two Body Mass Index (BMI) categories: obese and non-obese (healthy weight). For the evaluation the oral hygiene status, the study used Oral Hygiene Index (OHI) and Gingival Bleeding Index (GBI).

**Results:** According to the total sample, 5/60 obese (8.3%) and 57/120 non-obese (47.5%) had good OHI, while 23/60 obese (38.4%) and 3/120 non-obese (2.5%) were classified in a low level of OHI, with a significance between the groups ( $p < 0.001$ ), even after sorting by age. According to the classification of GBI, 60/60 obese (100.0%) and 89/120 non-obese (74.2%) had GBI 1 (bleeding gingiva), and 0/60 obese and 31/120 non-obese (25.8%) were classified as GBI 0 (healthy gingiva), with a significance between the groups ( $p < 0.001$ ), even after sorting by age.

**Conclusions:** This study indicated that OHI and GBI were significantly higher in the obese children group.

(Nutr Hosp. 2014;30:253-259)

DOI:10.3305/nh.2014.30.2.7476

Key words: *Pediatric obesity. Body mass index. Oral hygiene. Children.*

### ASOCIACION ENTRE LA OBESIDAD INFANTIL Y EL ESTADO DE HIGIENE ORAL

#### Resumen

**Objetivo:** El propósito de este estudio fue evaluar el estado de higiene oral en pacientes pediátrica con obesidad.

**Métodos:** Un estudio transversal realizado en Brasil en el período 2011-2012, que evaluó 180 pacientes pediátricos de 6 a 14 años, niños y niñas, reclutados en el Índice de Masa Corporal (IMC) y separados en dos categorías: obesos y no obesos (peso saludable). Para evaluar el estado de la higiene oral, el estudio utilizó Índice de Higiene Oral (OHI) y índice de sangrado gingival (GBI).

**Resultados:** De acuerdo con la muestra total, 5/60 obesos (8,3%) y 57/120 no obesos (47,5%) tuvieron buena OHI, mientras que 23/60 obesos (38,4%) y 3/120 no obesos (2,5%) fueron clasificados en un nivel bajo de OHI, con una significación entre los grupos ( $p < 0,001$ ), incluso después de la clasificación por edades. De acuerdo con la clasificación de GBI, 60/60 obesos (100,0%) y 89/120 no obesos (74,2%) tenían GBI 1 (gingiva sangrante), y 0/60 obesos y 31/120 no obesos (25,8%) fueron clasificados como GBI 0 (gingiva sana), con una significación entre los grupos ( $p < 0,001$ ), incluso después de la clasificación por edades.

**Conclusiones:** Este estudio indicó que OHI y GBI fueron significativamente mayores en el grupo de niños obesos.

(Nutr Hosp. 2014;30:253-259)

DOI:10.3305/nh.2014.30.2.7476

Palabras clave: *Obesidad pediátrica. Índice de masa corporal. Higiene bucal. Niños.*

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Recibido: 2-IV-2014.  
1.ª Revisión: 2-V-2014.  
Aceptado: 6-V-2014.

## Abbreviations

BMI: Body Mass Index.  
OHI: Oral Hygiene Index.  
GBI: Gingival Bleeding Index.  
WHO: World Health Organization.  
FOUFBA: Faculty of Dentistry, Federal University of Bahia.  
HUPES: Pediatric Gastroenterology Unit of the Complex.  
CPPHO: Pediatric Gastroenterology and Clinic of Obesity services.  
DMFT: Number of decayed, missing and filled teeth.  
TM: Trademark.  
SPSS: Statistical Package for the Social Sciences.  
CAPES: Coordination of Improvement of Higher Education Personnel.

## Introduction

Obesity is characterized as a condition in which a person has excessive body fat, whose origin is associated to genetic and environmental factors.<sup>1-4</sup> Obesity is now considered by the World Health Organization (WHO) as a global epidemic.<sup>5</sup> Obesity represents one of the most serious public health problems, both in childhood and in adulthood.<sup>6-8</sup> Moreover, obese children often become obese adults and with serious health risks in the short and long term.<sup>9-11</sup>

Considered a multifactorial disease, obesity causes limitations to the quality of life and is associated with several early and late complications, such as, cardiovascular, endocrine, metabolic, respiratory, liver disorders, and psychological and social disorders, as well as oral diseases, such as dental caries and gingival tissue changes.<sup>12,13</sup>

Studies have reported an association between gingivitis and periodontitis in obese adults.<sup>14</sup> As the main etiological factor for both diseases is represented by the accumulation of dental plaque, gingivitis is often observed in pediatric patients, whereas the diagnosis of periodontitis is less frequent in this group.<sup>15,16</sup>

Some studies have evaluated this association in adolescents. Modéer et al.<sup>17</sup> when evaluating 65 obese and 65 non-obese patients of both genders, 10-18 years old, observed that 17 obese and 5 non-obese showed higher visible plaque index than the others, with a significant difference between the groups ( $p = 0.005$ ). The presence of bleeding gingiva on probing was identified in 21 obese and 5 non-obese, with a significant difference between the groups ( $p < 0.001$ ). According to the authors, the hyperinflammation of the periodontal tissue of obese is more prevalent than compared to non-obese, and in obese this is exacerbated by the presence of proinflammatory cytokines.

Regarding the studies of Fadel et al.<sup>18</sup> based on the evaluation of clinical, microbiological and inflammatory parameters as indicators for caries and periodontal

disease in adolescents with obesity ( $n = 27$ ) compared to 28 controls patients, 13-18 years old, the results showed that individuals with obesity had significantly more decayed tooth surfaces and gingival bleeding than controls even after controlling for confounders. The authors are unable to confirm whether differences in caries and gingival inflammation are due to systemic changes that are associated with obesity or due to possible irregular dietary/oral hygiene habits.

Besides the susceptibility to systemic diseases, obese individuals usually consume large amounts of caloric food containing saturated fat and low nutritional values, which could contribute to a poor oral health<sup>19</sup>. Thus, this study was designed to evaluate the oral hygiene status in pediatric obese patients.

## Methods

### *Study design and sample*

This was a cross-sectional study, approved by the Ethics Committee of the Faculty of Dentistry, Federal University of Bahia (FOUFBA) under registration (process CAAE 0014.0.368.000-10, FR 343856). The study was designed as an observational comparative survey of oral hygiene status in obese children versus non-obese ones. Statistical power was calculated using means and variances obtained from a previous pilot study. Calculation revealed that the recruitment of 180 subjects ensured a power more than 95% with a 95% confidence interval. The data collection occurred in the period from March 2011 to June 2012, in Salvador, Bahia, Brazil. From a total of 180 patients, 60 obese followed at the Pediatric Gastroenterology Unit of the Complex HUPES-CPPHO (UFBA), and 120 non-obese (healthy weight) followed at the FOUFBA; both genders, ages 6-14 years were selected. Subjects affected by pathologies or major medical conditions such as diabetes, or any kind of diagnosed immunological syndrome or those who consumed medications that could increase gingival volumes were not included in the study. The parents of the patients signed an informed consent form. For diagnosis of obesity, the subjects were weighed in light clothing using an electronic scale (W 200/5-Welmy™) situation on a flat surface with a capacity of up to 200 kilograms, and their height was measured using a stadiometer to the nearest 5 millimeters. From these data, BMI was calculated using the Quetelet's equation (ratio of weight in kilograms by the square of height in meters). The result of the calculation was compared with the reference chart, according to WHO, in determining BMI percentile for children, both male and female.<sup>20</sup> Thus, patients were recruited into 2 groups: non-obese, for those in BMI percentile at or below the 85<sup>th</sup> percentile, and obese, for those in BMI percentile at or above the 97<sup>th</sup> percentile.<sup>20</sup> The patients with a BMI percentile between the 85<sup>th</sup> and 95<sup>th</sup> considered overweight were excluded. The parents of the

patients completed a questionnaire created for this study with questions about the eating habits, care of oral hygiene such as flossing and frequency of daily tooth-brushing. Soon after calculation of BMI, the individuals selected underwent clinical examination.

### Oral examinations

The clinical examination was performed by a single researcher dentist, aided by an assistant, in an appropriate environment with a dental chair and artificial lighting. Initially, the evaluation of the presence of dental plaque and supragingival calculus was performed using the Oral Hygiene Index (OHI), according to Greene and Vermillion<sup>21</sup> (1960), with air jets, a clinical mirror, and a WHO periodontal probe. The OHI is the combination of two components, the dental plaque index and the dental calculus index, which are estimated by 12 numerical determinations found in the labial and lingual/palatal surfaces of the teeth. The presence of dental plaque or dental calculus is examined in each sextant, using the tooth with the highest value for the calculation of the OHI. The value of the OHI (sum of the value of the dental plaque index and dental calculus index) can be classified as good (scores from 0 to 1.2), medium (scores 1.3 to 3), and low (scores of 3.1 to 6). After classifying OHI, we proceeded to Gingival Bleeding Index (GBI) to evaluate periodontal changes, such as the presence of gingival bleeding, with the aid of a WHO periodontal probe under the gingival sulcus of each permanent tooth present. The highest value score was recorded in the corresponding sextant to calculate the GBI. Thus, the result of the GBI for each patient was classified according to the following scores: code 0 (healthy gingiva), and code 1 (bleeding gingiva). Intra-examiner variability for OHI and GBI was assessed previously using a replicate examination of 10 young patients (aged between 10 and 14 years) and occurred 1 h after the first one. The researcher dentist was trained till reaching an intra-examiner calibration of more than 90% for both indexes. To exclude the effect of different status of dental permutation on plaque presence and gingival features, the indices were collected only from the first upper and lower molars and central and lateral incisors present in all subjects belonging to both groups. Sites on deciduous or newly erupted teeth were not considered in order to exclude the effect of exfoliation or immature status of the gingival complex on both plaque accumulation and inflammatory responses. During the clinical examination of the patients was also recorded the number of decayed, missing and filled teeth by the DMFT index.

### Data analysis

All data were entered in Epidata<sup>TM</sup> and then transferred to Statistical Package for the Social Sciences,

version 13.0 (SPSS, Chicago, IL, USA) for statistical analysis. The Chi-square test was used for analysis of qualitative variables. In the comparison of means between two groups was used Student's t-test. Were considered significant the associations with error probability of 5% ( $p < 0.05$ ).

### Results

The study sample consisted of 180 patients distributed into two groups: 60 obese and 120 non-obese. The data distribution of the groups in relation to age and sex, as well as on oral hygiene and diet are shown in table I. Regarding the evaluation of oral hygiene, 19 OB (31.7%) and 62 UH (51.7%) underwent dental evaluation at least once a year, and 5 OB (8.3%) and 50 UH (41.7%) brushed their teeth three times a day. These variables showed significant differences between groups ( $p < 0.001$ ). The practice of flossing was confirmed by only 2 OB (3.3%) and 23 UH (19.2%), demonstrating a significant difference between the groups ( $p = 0.004$ ), as shown in table I.

According to table II, the OHI mean value of the sample of obese was 2.65, and 1.37 in non-obese, with a significant difference between the groups ( $p < 0.001$ ), even after sorting by age. Regarding the OHI classification of the sample, only 5/60 obese (8.3%) and 57/120 non-obese (47.5%) showed good OHI, 23/60 obese (38.4%) and only 3/120 non-obese (2.5%) were classified in a low OHI, with a significant difference between the groups ( $p < 0.001$ ), even after sorting by age, as shown in table II.

The distribution of the sample according to the GBI classification (table III) follows: 60/60 obese (100.0%) and 89/120 non-obese (74.2%) were GBI code 1 (bleeding gingiva), whereas 0/60 obese and 31/120 non-obese (25.8%) were classified in GBI code 0 (healthy gingiva), with a significant difference between the groups ( $p < 0.001$ ), even after sorting by age, as shown in table III.

Regarding the DMFT index, 30 teeth (50.8%) in obese and 36 teeth (52.9%) in non-obese were decayed, 5 teeth (8.5%) in obese and 8 teeth (11.8%) in non-obese were missing, 24 teeth (40.7%) in obese and 24 teeth (35.3%) in non-obese were filled, without significant difference between groups ( $p = 0.734$ ).

### Discussion

Obesity and related diseases have in their dietary habits an important etiologic common component.<sup>2,22-24</sup> In addition to physical inactivity and genetic factors, some studies have shown that many health conditions are affected by both obesity and, for those overweight during childhood, psychosocial disorders, cardiovascular diseases, hepatic steatosis, joint changes, and the persistence of obesity into adulthood.<sup>13</sup>

**Table I**  
*Absolute and relative frequency of the sample according to sociodemographic characteristics, oral hygiene and eating habits of the obese and non-obese paediatric patients in Salvador, Bahia, Brazil, 2012*

Variables	Obese		Non-obese		Total		p
	n	%	n	%	n	%	
<i>Age</i>							
6-9 years	30	50.0	60	50.0	90	50.0	
10-14 years	30	50.0	60	50.0	90	50.0	
<i>Sex</i>							
Boys	30	50.0	60	50.0	90	50.0	
Girls	30	50.0	60	50.0	90	50.0	
<i>Frequency of dental evaluation</i>							
Not attending	34	56.7	32	26.7	66	36.7	< 0.001*
Once a year	19	31.7	62	51.7	81	45.0	
Twice a year	6	10.0	26	21.6	32	17.8	
Three times a year	1	1.6	0	0.0	1	0.5	
<i>Frequency of daily toothbrushing</i>							
Do not brush your teeth	1	1.7	0	0.0	1	0.6	< 0.001*
Once a day	18	30.0	8	6.7	26	14.4	
Twice a day	35	58.3	60	50.0	95	52.8	
Three times a day	5	8.3	50	41.7	55	30.6	
More of three times a day	1	1.7	2	1.6	3	1.6	
<i>Flossing</i>							
No	58	96.7	97	80.8	155	86.1	= 0.004*
Yes	2	3.3	23	19.2	25	13.9	
<i>Type of diet</i>							
Normal	30	50.0	98	81.7	128	71.1	< 0.001*
High-fat	12	20.0	5	4.2	17	9.4	
High-carbohydrate	16	26.7	17	14.1	33	18.4	
No answer	2	3.3	0	0.0	2	1.1	
<i>Consumption of sweets</i>							
Low	5	8.3	34	28.3	39	21.7	= 0.001*
Medium	32	53.3	68	56.7	100	55.6	
High	21	35.0	16	13.3	37	20.6	
Too high	2	3.4	2	1.7	4	2.1	
<i>Frequency of daily snacks</i>							
Once a day	0	0.0	6	5.0	6	3.3	< 0.001*
Twice a day	11	18.3	86	71.7	97	53.9	
Three times a day	40	66.7	27	22.5	67	37.2	
More of three times a day	9	15.0	1	0.8	10	5.6	
<i>Food consistency</i>							
Liquid	14	23.3	34	28.3	48	26.7	< 0.001*
Pasty	31	51.7	9	7.5	40	22.2	
Solid	15	25.0	77	64.2	92	51.1	

\*Chi-square-test.

The diseases that most commonly affect the stomatognathic system, such as dental caries<sup>25</sup> and periodontal disease, are caused by specific microorganisms found in dental biofilm.<sup>26</sup> In this context, the regular removal of supra and subgingival plaque can be considered as the main factor for preventing and treating these diseases. Furthermore, removal of the supragingival plaque is associated with the prevention of gingivitis and periodontitis.<sup>26</sup>

Although several authors reported an association between obesity and periodontal disease in adults,<sup>14</sup> few studies highlight this association in children, since none of these studies included groups of exclusively

children or adolescents. Thus, there is always a considerable heterogeneity in the age group evaluated, making it difficult to conclude whether a true correlation between obesity and periodontal disease indeed exists within a specific juvenile age group.<sup>19,27</sup>

In the present study, no difference was observed between the groups regarding the evaluation of the number of decayed teeth ( $p = 0.734$ ), however the results in table III highlight a higher prevalence of gingivitis (GBI code 1) in obese patients, for both age groups. This result is consistent with reports from Franchini et al.<sup>16</sup> which evaluated the prevalence of gingivitis associated with BMI in 98 patients (66

**Table II**  
Distribution of the sample according to OHI evaluation of the obese and non-obese paediatric patients in Salvador, Bahia, Brazil, 2012

Variables	Obese		Non-obese		Total		p
<i>Sample</i>							
Dental plaque index, M ± SD	2.62 ± 2.28		1.36 ± 1.63		1.78 ± 1.85		
Dental calculus index, M ± SD	0.03 ± 0.10		0.01 ± 0.03		0.02 ± 0.05		
OHI, M ± SD	2.65 ± 1.94		1.37 ± 1.36		1.80 ± 1.56		<0.001*
<i>6-9 years</i>							
Dental plaque index, M ± SD	2.53 ± 2.34		1.51 ± 1.69		1.85 ± 1.91		
Dental calculus index, M ± SD	0.02 ± 0.05		0.01 ± 0.02		0.01 ± 0.03		
OHI, M ± SD	2.55 ± 2.01		1.52 ± 1.43		1.86 ± 1.62		<0.001*
<i>10-14 years</i>							
Dental plaque index, M ± SD	2.71 ± 2.21		1.21 ± 1.58		1.71 ± 1.79		
Dental calculus index, M ± SD	0.05 ± 0.15		0.02 ± 0.05		0.03 ± 0.08		
OHI, M ± SD	2.76 ± 1.88		1.23 ± 1.30		1.74 ± 1.49		<0.001*
<i>OHI classification (sample)</i>							
Good, n / %	5	8.3	57	47.5	62	34.4	
Medium, n / %	32	53.3	60	50.0	92	51.1	<0.001**
Low, n / %	23	38.4	3	2.5	26	14.5	
<i>OHI classification (6-9 years)</i>							
Good, n / %	0	0.0	25	41.7	25	27.8	
Medium, n / %	23	76.7	32	53.3	55	61.1	<0.001**
Low, n / %	7	23.3	3	5.0	10	11.1	
<i>OHI classification (10-14 years)</i>							
Good, n / %	5	16.7	32	53.3	37	41.1	
Medium, n / %	9	30.0	28	46.7	37	41.1	<0.001**
Low, n / %	16	53.3	0	0.0	16	17.8	

M, mean; SD, standard deviation.

\*Student's t-test.

\*\*Chi-square-test.

**Table III**  
Distribution of the sample according to GBI evaluation of the obese and non-obese paediatric patients in Salvador, Bahia, Brazil, 2012

Variables	Obese		Non-obese		Total		p
	n	%	n	%	n	%	
<i>Sample</i>							
Code 0	0	0.0	31	25.8	31	17.2	
Code 1	60	100.0	89	74.2	149	82.8	<0.001*
<i>6-9 years</i>							
Code 0	0	0.0	15	25.0	15	16.7	
Code 1	30	100.0	45	75.0	75	83.3	=0.003*
<i>10-14 years</i>							
Code 0	0	0.0	16	26.7	16	17.8	
Code 1	30	100.0	44	73.3	74	82.2	=0.002*

\*Chi-square-test.

obese/overweight and 32 non-obese), both genders, 10-17 years old. The results showed that the gingival index was higher in obese/overweight (1.20) compared to non-obese (0.76), and the plaque index of the obese (1.42) compared to non-obese (0.77) was also higher. According to the authors, the main factor responsible for gingivitis is dental plaque accumulation. Furthermore, gingivitis observed in young patients with obesity is probably due to a combination of metabolic

disorders and inflammatory profiles, as a result of lack of care with oral hygiene procedures and information about diet.

The higher prevalence of gingivitis in obese in this study can be justified by the results of the interview regarding oral hygiene habits (table I), in which only 8.3% reported brushing their teeth three times a day, and only 3.3% reported flossing, which, as Rode et al.<sup>26</sup> characterized it, is one of the mechanical methods that is



among the most used preventive measures for the control of supragingival biofilm. Also, according to table I, 56.7% obese reported that they do not attend regular dental visits. Another important issue to note is that the obese appears to have lower overall healthcare assistance when compared to non-obese. This feature can also be reflected in their oral health and predisposition to increased risk of developing periodontal changes.<sup>16</sup>

A variety of potential mechanisms may explain the association between obesity and periodontal changes. Young overweight individuals may have unhealthy eating habits, such as inadequate intake of nutrients and excess sugar and fat, and such eating patterns can increase the risk for periodontal disease.<sup>28</sup> Moreover, alterations in host immunity or high levels of stress, which are often associated with excess fat gain in early life, may also play a role in developing disease.<sup>29</sup> Behaviors of low self-esteem and poor self-care in these patients, associated with social difficulties, also contribute to these results, as well as the probable influence of family behaviors.

The underlying biological mechanisms regarding the association of obesity with periodontitis are not well established. However, adipose tissue-derived cytokines and hormones may be one since the adipose tissue is not merely a reservoir of triglycerides, but also produces high levels of cytokines and hormones known as adipokines or adipocytokines, which in turn can affect periodontal tissues.<sup>30</sup>

Obesity may also influence the state of the periodontal disease due to increased levels of lipids and glucose in the blood, which in turn can have deleterious consequences for the host response, including changes in the levels of T cells, monocytes, the function of the macrophages, and increased cytokine production.<sup>30</sup> Thus, according to the biological plausibility of the association between obesity and periodontitis, obese individuals could have greater chance of tissue destruction in the presence of a lesion such as with periodontal infection.<sup>16</sup>

Pediatric dentists should consider the relationship between body composition and oral health of patients, since they are the first professionals to do the diagnosis of oral abnormalities.<sup>31</sup> It can be concluded in this study that the OHI and GBI were significantly higher in the obese children group, even after sorting by age. Moreover, we highlight the importance of teaching parents about the care needed with the oral hygiene for their children at this stage of life, especially in obese patients, who are more susceptible to gingival inflammation. All health professionals should have the knowledge to act in the prevention of obesity and prevention of diseases of the oral cavity, which are common in the currently.

## Acknowledgments

We thank the Coordination of Improvement of Higher Education Personnel (CAPES) for their assis-

tance in the form of scholarship to the first author. We thank the Pediatric Dentistry and Cariology disciplines (FOUFBA) and Pediatric Gastroenterology and Clinic of Obesity services (CPPHO) for supporting the development of this study.

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